A Research Proposal

On

Evaluation of water quality around the proposed bioremediation Adharwadi dumping ground site in kalyan City, Thane, Maharashtra: An Environmental Site Assessment

By

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1. Abstract of proposed work plan/ Problem:

Kalyan Dombivli city is one of the nearest city to Mumbai Metropolitan city and has experienced haphazard development in recent years. The city has age old Adharwadi dumping ground with landfill site without any scientific dumping. The same was now being converted to Ring Road and partly proposed to be converted to city park as the NGT ordered the closure of dumping site and to start with scientific landfill site at other location. As this site was previously was outskirt of city but due to past fast pace development which is happened in and around the dumping site, made the life vulnerable due to its vicinity to residential zone. The Adharwadi dump site is now officially declared as abandoned site for further dumping of Municipal waste since March 2021. As per the dumping closure norms prescribed by Central Public Health and Environmental Engineering Organisation(CPHEEO) and MoEFCC, the baseline environmental monitoring is necessary before closure of Dumping ground. Biomining/ Bioremediation is suggested instead of Biocapping by NGT orders OA 519/2019 dated 17/7/2019. But due to city pressure and new ring road which is passing through the Adharwadi dumping ground may end up in haphazard closure of the dumpsite without following the standard norms by appointed independent contractor by KDMC. Study of Baseline environment in an independent study will give unbiased sampling results along with proper interpretation and correlation establishment of major Environment resource ie ground water. The closure of Dumpsite without proper stabilisation of waste may result in long term effects on the surrounding. Being this site is in core of surrounding developed city, the closure should be done in systematic and in scientific way. The current study will establish the current scenario of leachate pollution potential and current ground water pollution status and its correlation with the dumpsite. The findings will not only help to select the technology and adoption of suitable methods for scientific closure but also will establish a baseline data which can be further referred to for establishment of success or failure of Dumpsite closure.

2. Introduction:

Kalyan Dombivili is the city situated next to Mumbai Metropolitan city. The city experienced urbanisation at fast pace in last decade. As Mumbai is now no longer place to settle down for the Mumbaikar’s due to tremendous hike in housing cost, Kalyan Dombivili city is now looked upon as affordable and cheaper housing for settling down in kalyan due to its low lifestyle cost as compared to Mumbai. Thus, city attracts many people from nearby areas who came to Mumbai

for livelihood and career. Thus, sudden growth in kalyan city has created challenges of urbanisation. Solid waste Management is one of them.

While entering the city from Bhiwandi Kalyan bypass road, any citizen first finds the sight of Durgadi Fort at one end and big hill of Adharwadi Dumping ground at other end. Adharwadi Dumping site which was set up in the kalyan city in 1963, which was previously outside the city. But after 1990's sudden growth and urbanisation of city took place in such a fast pace that the Adharwadi Dumping ground which was previously outside the city now become the internal part of city as in and around development of housing complexes took place in recent years.

Adharwadi dumping ground site is spread over more than 6 acres and very close to ulhas Creek. Since high court order 2017, the National Green Tribunal has directed the Local planning authority to close down the dumping ground scientifically and start the scientific landfilling, as the capacity to hold the waste is over for this location and the pollution problems due to this dumping ground to nearby resident has aggravated the problem. Currently the 650 metric tonne of waste is getting generated in KDMC area every day. It was still dumped in the same dumping ground. As the KDMC has identified 3 locations in KDMC area for Scientific landfill ie. Umbarde, Barave and Manda at Titwala. Recently KDMC has got green nod for the scientific landfill site development at above locations. Based on that recently in March 2021, Civic body Kalyan Dombivili Municipal Corporation (KDMC) has declared the official closure of this Dumping ground and now no more waste will be dumped in this site.

Also, a Ring Road is proposed which is partly going through the Adharwadi dumping ground area which is a major connectivity from Dombivili to titwala via kalyan, makes it inevitable to scientifically close the dumping ground.

As per the Swachh Bharat Mission – Urban, Central Public Health and Environmental Engineering Organisation (CPHEEO) and Ministry of Housing and Urban Affairs, Government of India has issued guideline for scientific closure of dumpsite and land reclamation. [1]

Accordingly, the Adharwadi Dumping ground Bioremediation process has been started. But the location of adharwadi dumping ground and being in the mid of developed city, there are many issues which needs to be tackled in scientific way to reduce the environmental impacts before closure of dumping ground.

Location of Adharwadi Dumping ground:

- The dumpsite is located at west of kalyan City.
- Latitude:19°15'1.57"N
- Longitude: 73° 7'8.89"E
- Total Area covered:18.7 acres (as per google Location)

Figure 1: Goolge Location of Adharwadi Dumping ground

Environmental risk prone areas in the vicinity of dumping ground

- Ulhas Creek (abutting to dumping ground)
- Residential development within one kilometre of the dumping ground
- Usage of Borewell water in the nearby residence for the secondary purposes.
- Nearby Farming fields.
- Animal Husbandry (Dudhnaka) where rearing of buffaloes for milk is one of the activities which is close to dumping ground.

As this legacy waste is recommended for bioremediation instead of bio capping, a complete waste recovery and stabilisation is expected. As this is very close to all residential development and considering the human health at high-risk stabilisation and bioremediation should be monitored in stringent way. It is recommended by Land reclamation procedure to have baseline environment study before start of bioremediation. Hence study of Site environment parameters

such as baseline study of heavy metals in surface and subsurface soils and water, rainfall, soil type, surface hydrology, topography, wind direction etc. is need to be analysed before and after bioremediation.

This data will help to establish ULB in following ways

1. Level of Environment pollution in current scenario
2. To frame the strategy of Bioremediation in holistic way after understanding the Environmental risk
3. Monitor the progress of bioremediation in terms of its effectiveness.

Hence in proposed study, as a research scholar I am proposing to study the Baseline environment in and around the Adharwadi dumping ground.

In this study, I am proposing evaluation of surface as well as ground water quality monitoring around the proposed bioremediation Adharwadi dumping ground site in kalyan City, Thane, Maharashtra.

3. Review of Literature and Development in the subject (Previous Work done in the relevant area):

Many research papers have been published in recent years mainly focusing impact of leachate on ground water. Swatch Bharat Abhiyan in India is mainly focusing on Solid waste Management and many CPCB and State guidelines are published to make the solid waste management more sustainable and economical. In most of the cities solid waste has been dumped in an opened and unlined ground. Over a period of years, the heaps of unsegregated waste have been accumulated on such unlined ground. Different studies in India and worldwide proved that over a period the decomposition of unsegregated waste generates liquid which is containing some complex organic and inorganic compounds which is known as leachate. This liquid leachate seep till bottom of the landfill and because of unlined ground its further percolates in soil and contaminate the ground water source.

Study done on municipal solid waste landfill sites of erode city, Tamil Nadu, Indiahas assessed the impact of leachate percolation on surrounding groundwater quality. The concentrations of Cl-, NO3 - , SO42-, NH4 + were found to be in considerable levels in the groundwater samples

particularly near to the landfill sites, likely indicating that groundwater quality is being significantly affected by leachate percolation. The presence of contaminants in groundwater particularly near the landfill sites warns its quality and thus renders the associated aquifer unreliable for domestic water supply and other uses. [2]
A similar case study was conducted for the Pirana site in western India, to assess impact of landfill on groundwater quality. Here the focus was given to quality and toxicity of waste with respect to heavy metals and its impact on ground water. Results of this research paper also suggest the existence of an empirical relationship between some specific indicator parameters like heavy metals. In this study a particular attention was also given to the wells situated down gradient of the landfill and in the direction of groundwater flow. [3]

Also, in similar kind of the study carried out in village Kasaba- Bawda, Kolhapur district, Maharashtra, India, shows that the pH varied between 6.5 to 7.1, hardness between 173 to 422 mg/L and presence of organisms (MPN) including that, the water from the water sources located in the vicinity of solid waste dumping sites were slightly polluted making the water unfit for drinking. It was also noticed that the ground water samples are much polluted which are located near to dumpsite than the samples which are located away from the dumpsite. [4]

In one of the research papers carried out in Pune metropolitan city focus on pollution potential of leachate from landfill siteand its impact on shallow basaltic aquifers shows that leachate pollutionindex (LPI) and ground water quality show seasonal variations in sample collected pre-monsoon and post monsoon. The influence of leachate percolation (through two different modes) is evident onthe surrounding wells. Besides meagre lithogenicinputs from rock–water interactions in basalticlitho-environment, the leachates are the primesource of all ions in the groundwater. High LPIvalues indicate that the leachates generated fromdumping site are not stabilized, resulting in highconcentrations of heavy metals in leachate. Despitetheir high concentrations, the groundwatersare least affected in terms of heavy metal contents,plausibly due to redox controls. [5]

A report by Maharashtra pollution control board on status of Municipal Solid waste Management in Municipal corporations (Maharashtra) has covered total 26 cities in Maharashtra

including kalyanDombivili City which is an area under reference. The official figure disclosed in the report as on year 2014 shows the dumping waste 550 MT/M which was being dumped at adharwadiduming site which was non approved unscientific disposal site. Various show cause notices were issued along with prosecution due to unscientific dumping carried out on this site. Total population mentioned in the report for KDMC area is 14,28,338 and the dumping site area mentioned in report is Approx. 4 - 5 Acres. [6]

Another study of research paper on Reclamation of landfills and dumps of municipal solid waste in an energy efficient waste management system: methodology and practice, shows that Theoretical and practical results allow asserting the necessity and demand for reclamation of dumps and closed landfills of municipal waste in order to stabilize the ecological state of the environment and re-develop the territory. The technology of reclamation and the choice of perspective use of land plots depend on the qualitative and quantitative parameters of the object, which are established as a result of geopedological surveys. [7]

In one of the research projects of landfill leachate contamination using physicochemical indicators and toxicity test shows some of the highlights like

1. EC is strongly linked to TDS,
2. High COD values may indicate that waste decomposition processes are not yet stabilized,
3. AN is the main form of nitrogen present in leachate from landfills.
4. Showed strong positive correlations between: Mn, Cd, EC, Cl-, Na, TU, Fe, Ca and ON.
5. Negative correlations occurred between: TDS and Mg, ON and K and TU, Na and TS. [8]

One of the research papers who emphasis on Characterization of Leachate from Municipal Solid Waste (MSW) Landfilling Sites of Ludhiana, India. The data presented in this study indicated that the age of the landfill has a significant effect on leachate composition. In older landfills, the biodegradable fraction of organic pollutants in the leachate decreases as an outcome of the anaerobic decomposition occurring in the landfill. The concentration of leachate contaminants at new landfill sites were comparative greater than that of landfilling site which is older. In this BOD/COD ratio is compared for the same. the strength of leachate decreases with time due to biological breakdown of organic compounds and precipitation of soluble elements such as heavy metals. Due to its biodegradable nature, the organic compounds decrease more rapidly than the

inorganic compounds with increasing age of leachate production. Therefore, the ratio of total volatile solids to total fixed solids (VS/FS) decreases with the age of the landfill. [9]
Besides the wates' characteristics, few factors are named as contributors to the temporal leachate quality as well, for instance, the site location, management practice, depth of solid wastes, rainfall pattern, water percolation's rate, soil characteristics, internal treatment processes, and age of landfill. The surrounding temperature and moisture content also play big roles in the composition of leachate. As the landfills get older, the activity of anaerobic decomposition in the site will reduce the biodegradable fraction of organic pollutants, thus cause stabilized leachate become higher pollutedwastewater compare to the young ones. Typically, old leachate is harder to be treated. This address that it is important to carry out leachate characterization first to have a successful treatment strategy. [10]

4. Objectives of Research / Proposed Hypothesis:

Being Adharwadi landfill site is operating since 1963 and closed for new addition of any waste since March 2021, there are some dumping is seen due to non-operation of new scientific landfill sites at its full capacity.

Being this is old dumpsite the Biodegradable components may have been stabilised over a period. As this is age old dumpsite, there is no leachate collection pond or the separate arrangement to collect the leachate. Hence leachate collection may be a challenge for this site. But still if low lying area where because of slope, the trickled down water can be collected and analysed before moving to ground and surface water quality.

Following are the broad objectives listed based on the factual site conditions as well as based on research paper review and need of this study before scientific closure of Dumpsite.

1. To prepare the baseline Environmental data before closure of dumpsite.
2. To identify the ground water quality around dumping site.
3. To identify the surface water quality especially creek water and lake water around dumping site.
4. To identify the leachate contamination potential of the site or to identify pollution potential of dumping site.
5. To identify the soil contamination due to dumping site.

6. To suggest the remedial measures to safeguard of soil and water resources with respect to closure of dumpsite.

5. Methodology to be adopted:

5.1 Study Area:

Adharwadi dumping ground earmarked on google image is the dumpsite identified for study purpose. The area around the

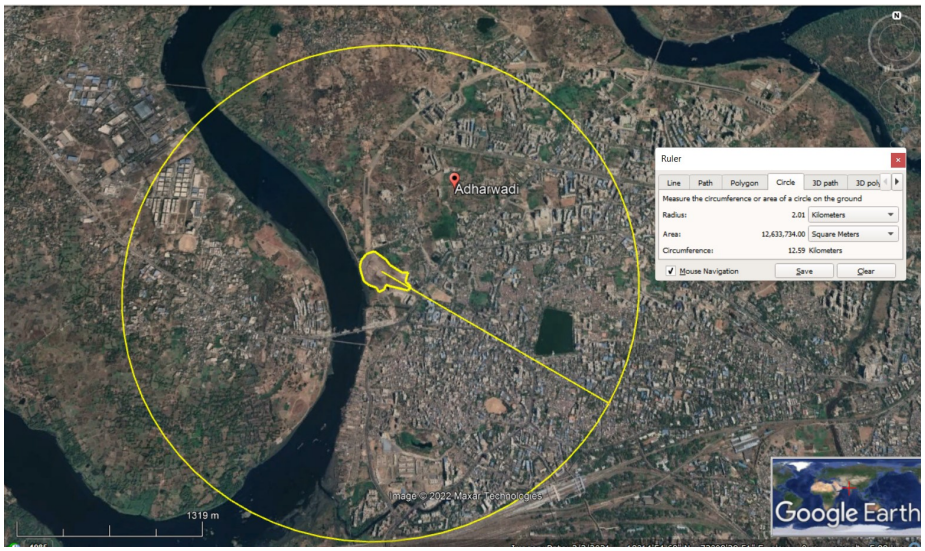

Figure 2: Study area of 2KM in and around the Adharwadi Dumpsite

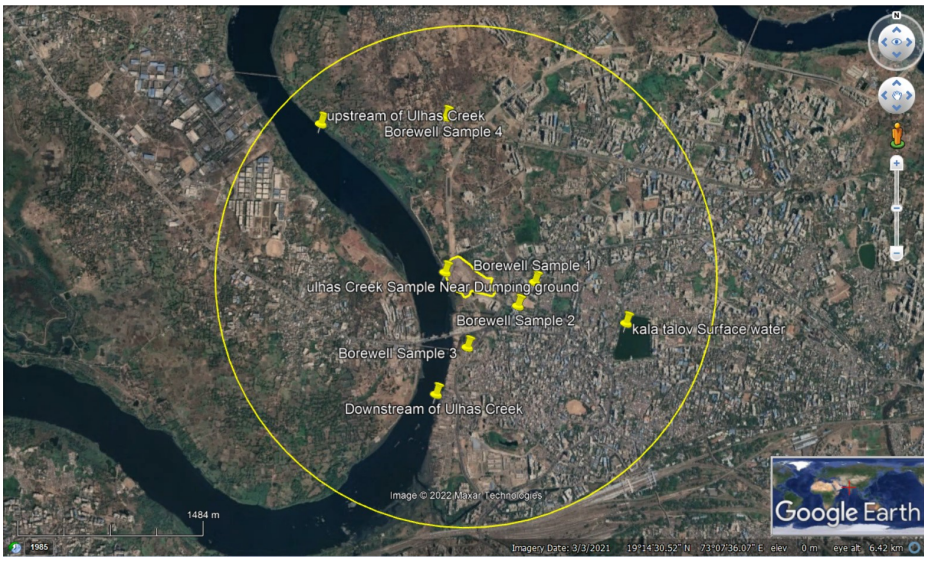

Figure 3: Study area with Surface and Ground Water sampling location around the Dumpsite

5.2 Sampling:

A random sampling method will be employed to collect the surface water sample and groundwater samples. Sampling will be done upstream, downstream of ulhas creek along with location which is immediate abutting to Dumping site. For ground water sample the consideration will be given to present landuse pattern, topography and purpose of usage of ground water for the areas which are close to dumping site. Ground water sample especially taken as representative sample ie one from village which is used for agricultural purposes. One ground water sample will be taken from residential building where the borewell water is being used for secondary purposes of domestic water other than drinking. One borewell sample is taken from the Buffaloes rearing campus. This borewell water sample is used for drinking, bathing and cleaning purposes in animal husbandry. Borewell samples were taken in radial direction to cover dumping ground all around in immediate vicinity. Samples will be taken in non-monsoon period especially May 2022 (Pre monsoon Sample) and November 2022 (Post Monsoon Sample)

The Surface water sample and Ground water samples will be collected in pre cleaned polyethylene bottle. Certain parameters like pH and Total Dissolved Solids(TDS) will be recorded at site at the time of sampling with the help of calibrated digital pH meter and TDS meter respectively. For Biochemical oxygen Demand (BOD) glass bottle of 300 ml will be used. Dissolved oxygen of samples will be immediately fixed at the time of sampling. For heavy metals sampling the water will be collected in prewashed polyethylene container of 100 ml. The sample will be acidified to eliminate the precipitation of heavy metals.

Besides this the untreated leachate samples will be collected in every 2 months except the monsoon period. Ie Samples will be collected in May22, Oct22, Dec 22 and Jan 23, March 23 in similar way as above from the adharwadi Dumping ground site.

After sampling the samples were brought immediately to the laboratory and kept in refrigerator at temperature below 4^0C until analysed (APHA 1995)

5.2. Physicochemical analysis of landfill leachate, Surface and ground water sampling:

In the leachate samples, the parameters which will be studied as prescribed in Solid waste Management Rules 2016. In the notification 19 Parameters of leachate are given along with standards of Disposal. The Leachate sample will be studied on those 19 parameters and cross

verified against the standards given in the notification. Suspended Solids (SS), Dissolved Solids(inorganic), pH, Ammonical Nitrogen (as N), Total Kjeldahl nitrogen (as N), Biochemical oxygen demand (3 days at 27^0 C), Chemical oxygen demand, Arsenic (as As), Mercury (as Hg), Lead (as Pb), Cadmium (as Cd), Total Chromium (as Cr), Copper (as Cu), Zinc (as Zn), Nickel (as Ni), Cyanide (as CN), Chloride (as Cl), Fluoride (as F), Phenolic compounds (as C6H5OH).

5.2. Physicochemical analyses of Surface Water and Borewell Sample:

Borewell Samples and Surface water samples will be studied for different physicochemical parameters and following test methods will be adopted for the same.

Table 1 : Physicochemical analysis parameters and their test methods

Sr. No.	Test Parameter	Test Method
1	pH	IS:3025(P- 11)1983
2	Color	IS:3025 (P-4)1983
3	Odor	IS:3025(P- 5)1983
4	Taste	IS:3025(P- 7,8)1984
5	Turbidity	IS:3025(P- 10)1984
6	Total Hardness (as CaCO3)	IS:3025(P-21)1983
7	Ammonia	IS:3025(P- 34)1988
8	Residual Free Chlorine	IS:3025(P- 26)1986
9	Total Dissolved Solid	IS:3025(P- 16)1984
10	Chlorides (as Cl)	IS:3025(P- 32)1988
11	Fluoride	IS:3025(P- 23)1964
12	Arsenic	IS:3025(P-37)1988
13	Iron (as Fe)	IS:3025(P- 53)2003
14	Nitrate	IS:3025(P- 34)1988
15	Sulphate (as SO4)	IS:3025(P- 24)1986
16	Selenium	IS:3025(P- 56)1988

17	Zinc	IS:3025(P- 49)1994
18	Mercury	IS:3025(P- 48)1994
19	Lead	IS:3025(P- 47)1994
20	Copper (as Cu)	IS:3025(P- 42)1992
21	Cyanide	IS:3025(P- 27)1986
22	Chromium	IS:3025(P- 52)2003
23	Nickel	IS:3025(P- 54)2003
24	Cadmium	IS:3025(P- 41)1992
25	Thermo tolerant coliforms or E. coli	IS: 1622-1981 (R-2009)

Major cations like Ca2+, Mg2+, Na+and K+ will be analysed on Flame Photometer. Concentrations of Cd, Cr, Cu, Ni, Pb and Zn will be determined by atomic absorption spectrometry (AAS). The chemical analysis was carried out asper the standard procedure given in APHA (1995).Nitrate analysis will be performed using Brucine Methodusing UV Spectrophotometer and Chloride will be determined with Ion Selective Electrodes.

5.3. Statistical Analysis:

The results of parameters will be interpretated with the use of different statistical analysis by using SPSS. SPSS is a complete system for analysing collected data. It can obtain data from any type of file and use them to produce tabulated reports, plots of distributions and trends, charts, descriptive statistics, and complex statistical analysis. It is one of the best widespread statistical packages which can implement extremely complex data manipulation and analysis with easy instructions. SPSS is expert of handling huge quantities of data and can execute all of the analyses covered in the text and much more long produced by SPSS Inc., it was developed by IBM in 2009. [11]

6. Importance of Study/ Society Application:

Adharwadi dumping ground is an age-old problem faced by many nearby residents for past 20 years after sudden development of urbanisation in and around the dumping site. Municipal corporation failed to close the dumping ground in 2014 and delayed the closure activities due to many reasons, one of the reasons is the new scientific landfill site approvals got prolonged due to strong opposition from the local villagers. But since year 2021 the approved Scientific landfill site got ready and fully operational, the current Adharwadi dumping ground closure become one of the priorities to KDMC.

As the ring road passing through the 25% parts of the adharwadi dumping ground, there may be chances of use of this leftover material for levelling purpose and unscientific closure may be practiced unknowingly by contractors appointed by municipal corporation. If the Baseline data of ground water and surface water analysis is available with statistical interpretation then the future haphazard closure of adharwadi dumping ground can stopped or can be avoided. Also, the baseline data can be utilised as a benchmark for further treatment schedule and treatment method adoption.

The current analysis will also help the Municipal corporation to planned future Solid waste development sites which are their pipeline project too.

As there are NGT orders and strict compliance orders by MPCB to local municipal authority, this study will help them as path finder and also safeguard their purpose of scientific closure.

Statistical analysis of Physicochemical analysis of ground water and surface water will also help in pollution load and age of Dumping ground site and leachate potential of the site. This will help to frame further treatment methods, different technology adoption for stabilisation of dumpsite. This will also help to understand future framework and planning of closure of dumpsite.

Analysis of ground water samples in residential area and animal husbandry area will help to understand the potential of health risk if any due to usage of the ground water. Identification of pollution load and its content help to identify the safety in consumption or usage of these Borewell water as well as to identify suitable treatment method adoption for water treatment before usage of the Borewell water. If the potential risk of such borewell water is found high

then banning of usage of such borewell can be done through awareness. This will stop the further risk and hazards to the Human and animal life.

Borewell samples in remote location will be also analysed in the current study especially in agricultural usage. The leachate potential travel pattern can be established by this study and thus will help in adoption of certain mitigation measures in future.As the life of Dumpsite is already over, but the potential hazard of dumpsite is still not over. The study will establish that potential and further work can be done in this regard to adopt suitable mitigation measures to prevent those hazards.

7. Proposed work plan / Formulation and structure of study:

The study involves 3 parts ie. First part includes Actual survey of site, sampling plan preparation, Approvals from Government body to access the site, approval of sampling locations and sample frequency from the guide, do the necessary changes in sample location and frequency based on the site visit output like accessibility, relevance, exclusion etc.

Second part of the study is actual sample collection and analysis. The sample collection and analysis will be done as per the detailed material method identified. The analysis results will be verified and discussed with guide immediately. After that if there is change in sampling location or frequency or change in parameter analysis that can be accommodated in repetitive sampling or in future sampling.

Third part of study is Interpretation of data and statistical analysis along with thesis writing. This needs to be done judiciously. For this data recording and data gathering should be systematic and in consistent way. Thesis writing will be adopted throughout the sampling and analysis. Last few months will be kept to review, rewrite or revisit the documentation done and fine tuning of the same with new literature survey and our findings in consolidated manner.

The same is identified in Gantt Chart as given below.

7.1 Year wise Plan of work and Targets to be achieved

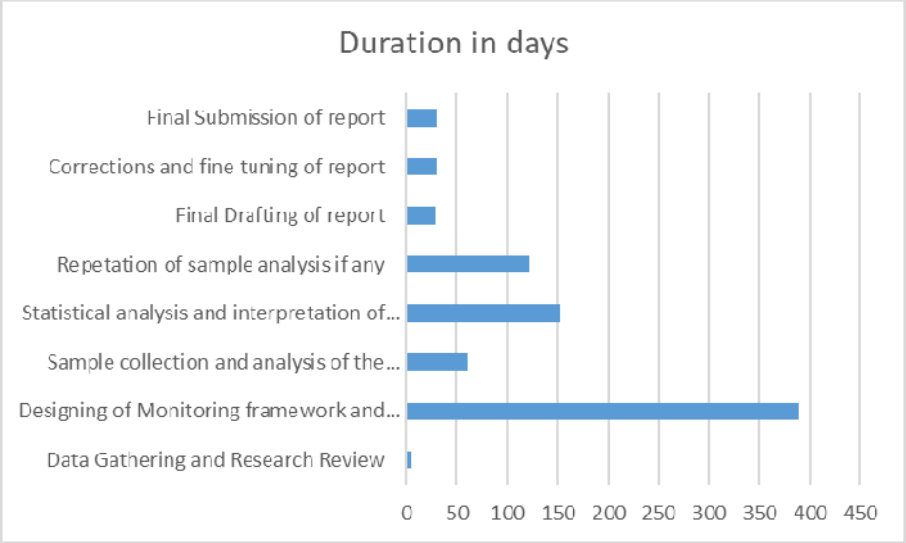

Figure 4: work plan of Research Proposed

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